Professor Robinson, in reply, said he was rather surprised that some of his colleagues still insisted on defining intensive care patients as those who were critically ill. Intensive patient care should become part of progressive patient care, and it was essential to distinguish between the heavy nursing areas and those dealing with patients who were so desperately ill as to require the support of vital functions. Careful nursing observation and care should never be done in an intensive therapy unit: it was very wasteful of the facilities and of the highly trained nursing staff capable of using the complex equipment. Heavy nursing could be done by nurses with the usual level of training. It should not be thought that an intensive care unit undertook the long-term treatment of respiratory cripples. The patient who required ventilation for a virus pneumonia or a crushed chest was not a respiratory cripple, nor could the patient requiring triple pulse cardiac pace-making for ten or fourteen days to restore adequate cardiac function after cardiac failure be regarded as suffering from a chronic illness. It was rare that patients who required mechanical or electronic support for their vital functions could be restored to health within three or four days.

Meeting May 6 1966

Registrar's Prize Essay

The Management of Acute Upper Airway Obstruction in Childhood

by J B Owen-Thomas[1] MB FFA RCS
(Intensive Therapy Unit,
Alder Hey Children's Hospital, Liverpool)

The consequences of untreated upper airway obstruction in childhood have occupied a tragically common place in medical literature, graphically recorded by Francis Home in 1765 as he described 12 young deaths from croup. The anæsthetist is now often called to co-operate in the management of medical emergencies and one of his principal duties is to be familiar with various types of airway obstruction, particularly in children, since acute dramatic situations may arise demanding immediate action.

Techniques of resuscitation have been slow to develop. Vesalius in 1543 demonstrated the role of ventilation of the lungs in maintaining life but no scientific approach to resuscitation existed until Dutch workers experimented with methods to revive the apparently dead from drowning (Herholdt & Rafn 1796) and Charles Kite of Gravesend, in 1788, described oral and nasal intubation of the larynx for use in resuscitation. He and John Hunter stressed the importance of a clear airway and artificial ventilation as the first line of treatment of respiratory failure. Success with this technique in practice led to the establishment of an early intensive care unit at the Liverpool Infirmary in 1775, its aim being to co-ordinate skills necessary to treat patients needing urgent resuscitation and attention to the airway (Liverpool Medical Institution 1775).

[1] Present address: Department of Anæsthetics, Hospital for Sick Children, Toronto, Canada

Acceptance of the use of an artificial airway to relieve upper airway obstruction in adults met with some opposition, tracheostomy usually being preferred (Bichat 1798, MacEwen 1880). O'Dwyer (1885), using instruments specially designed for intubation, successfully relieved airway obstruction at the laryngeal aperture in infants. The development of endotracheal intubation as we know it today arises from the work of Magill who pioneered endotracheal techniques for cleft palate and hare lip operations in infants, using gum elastic catheters passed nasally (Magill 1965, personal communication) and demonstrating the ready availability of an alternative airway to the mouth.

This essay reviews the patients admitted to Alder Hey Children's Hospital with upper airway obstruction over the period 1955 to 1965, and draws upon the experience gained in their management as they confront the anæsthetist.

There were 241 patients who had upper airway obstruction (Table 1), their ages ranging from birth to 14 years. Fifty-six (23%) required emergency intubation and, of these, 17 (7%) were treated by tracheostomy and a further 16 (6·6%) by prolonged nasal intubation.

Of the 241 patients 11 received intermittent positive pressure ventilation (IPPV); 10 were neonates and were ventilated for bronchopneumonia. One patient, aged 4½ years, received IPPV to maintain life after irreversible cerebral hypoxia had occurred from upper airway obstruction due to laryngotracheitis. Twenty-seven patients (11%) died.

Upper Airway Obstruction due to Laryngotracheitis

One-hundred-and-fifty-three patients were admitted with stridor, with or without cyanosis when breathing air (Table 2); 21 patients had

Table 1
Patients admitted with upper airway obstruction 1955–65

Disease	Average age	No.	Intubation: Emergency oral	Intubation: Prolonged nasal	Tracheostomy	Dead
Laryngotracheitis	3 years (1–14 years)	153	21	12	5	4
Neonatal	<1 month	44	20	–	10	19
Foreign body	4 years (1–12 years)	18	5	–	–	1
Other causes	5 years (2 weeks–12 years)	26	10	4	2	3
Total		241	56 (23%)	16 (6·6%)	17 (7%)	27 (11%)

Table 2
Upper airway obstruction due to laryngotracheitis

	No.	Average age	Average duration of obstruction prior to admission	Average duration of stay in hospital
Mild	132	2½ years (6 months–14 years)	54 hours (1–21 days)	9 days (1 day–8 weeks)
Severe	21	4 years (2–7 years)	12 hours (<6–48 hours)	17 days (1–25 days)

severe airway obstruction which required emergency relief. Of these 21 patients, 17 had increased respiratory effort and were in a state of cardio-respiratory failure (collapse) and 3 developed a cardiac arrest shortly after admission: they required emergency oral intubation, external cardiac massage and correction of metabolic acidosis by intravenous sodium bicarbonate solution. They all survived with no sequelæ. The remaining 4 patients, who were moribund on admission due to airway obstruction, are described separately.

The duration of airway obstruction in severe laryngotracheitis was twelve hours, which was much shorter than in mild laryngotracheitis. The duration of stay in hospital of the severe group was, however, the longest, seventeen days (Table 2). Seventeen patients required active intervention to the airway and prolonged nasal intubation followed in 12 patients for periods varying from one to twenty-five days. Tracheostomy followed in a further 5 patients for periods ranging from five to fifteen days. Organisms cultured from the throat swabs and post-nasal swabs of the whole group of 21 patients included *Hæmophilus influenzæ*, *Staphylococcus pyogenes*, *Streptococcus viridans*, *Pneumococcus* and *Pseudomonas pyocyaneus*. Appropriate antibiotic therapy was instituted.

This contrasts with the group of 132 mild cases of laryngotracheitis in whom no pathogenic organisms were cultured from throat or post-nasal swabs, who responded satisfactorily to treatment with antibiotics and a humid atmosphere and, in some instances, steroids.

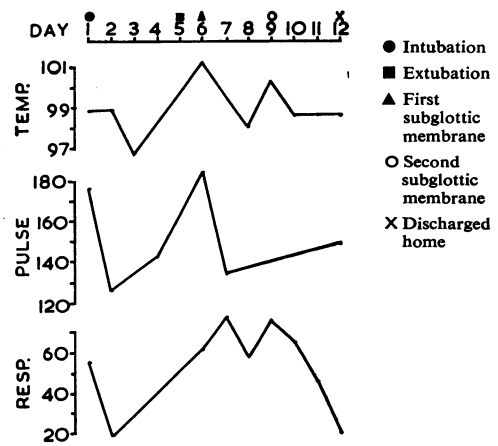

Fig 1 **Case 1** *Summary of illness*

Case 1 *Severe Laryngotracheitis*
K B, girl aged 2½ years
History: Twenty-four hours' nasal catarrh, with acute stridor and dyspnœa twelve hours before admission.
On admission: Pale, but not cyanosed. Body temperature 99·5°F (37·5°C). Pulse 180, regular and of small volume. She was breathing with marked effort at a rate of 80 per min. She was semiconscious and there was evidence of circulatory failure.
Emergency laryngoscopy was performed under general anæsthesia, using 100% oxygen with halothane delivered via a modified Rees 'T' piece with spontaneous respiration. Laryngoscopy showed a red œdematous epiglottis and aryepiglottic folds obstructing the larynx. The vocal cords were barely visible. Intubation was performed with a 4mm diameter naso-endotracheal tube.
Course: After intubation there was immediate relief of symptoms; the pulse rate slowed to 130, and the respiratory rate dropped to 30 per min with no evidence of obstruction (Fig 1). Subsequent treatment was by prolonged nasal intubation for five days in an atmosphere of high humidity and oral feeding was possible soon after intubation. Culture of the throat swab yielded *Staph. pyogenes* and *H. influenzæ*, both resistant to penicillin. Hb 81%; WBC 28,000.

Twenty-four hours after extubation a rise in respiratory and pulse rates occurred, with a marked stridor associated with increased respiratory effort and intercostal recession. This was relieved by removing a subglottic membrane lying at the level of the cricoid ring, but after twenty-four hours the respiratory rate rose again and marked stridor reappeared. A second subglottic membrane was removed; this was followed by permanent relief of symptoms and the child went home three days later.

Table 3
Post-extubation obstruction (subglottic): 12 patients with severe laryngotracheitis

	No.	*Mean duration of intubation*
With membrane	3	6·6 days (2–10 days)
Without membrane	9	7·1 days (1–25 days)

Subglottic membranes have been described following prolonged intubation (Lu *et al.* 1961) and, out of 12 patients with severe laryngotracheitis treated by prolonged nasal intubation, 3 had a subglottic membrane forming a cast of the larynx. Histologically the membranes consisted of fibrin and epithelial debris. Duration of intubation does not appear to be the main factor in their formation (Table 3): of 12 patients intubated for comparable periods, 3 developed a membrane and 9 did not. Too large a diameter of tube may be a contributory cause in the formation of subglottic membranes and it is now the practice to use a nasal tube which is slightly smaller in diameter than the tube used for oral intubation (Rees & Owen-Thomas 1966).

In order to help the anæsthetist in diagnosis and management of severe airway obstruction due to laryngotracheitis, an investigation was made to find out how patients who need active treatment to the airway differ from the mild group treated conservatively. A clinical and biochemical investigation was therefore made on 12 patients with severe upper airway obstruction treated by prolonged nasal intubation.

Clinical investigation: A questionnaire was sent to family doctors attending 12 patients admitted to hospital with severe upper airway obstruction due to laryngotracheitis. Eight doctors replied to the following four questions: (1) Why did the parents call you? (2) Please comment on the impressive clinical features of your patient. (3) How did your patient differ from other cases of stridor you have experienced? (4) How many children with stridor have you seen this winter?

Each family doctor reported the main request for consultation as 'fear of interference with breathing'; 'restlessness, toxicity and the obvious obstruction to breathing' were the impressive clinical features. These 8 patients differed from others seen with stridor in that the history was short, collapse occurred without warning and the patient was 'pale, ashen or pallid' in appearance; there was extreme restlessness and difficulty with the examination. Each doctor saw from 1 to 12 children with stridor during that winter, all of whom were treated conservatively.

Biochemical investigation: The acid-base balance of 8 patients admitted with severe upper airway obstruction due to laryngotracheitis was estimated before and after intubation. Capillary blood samples were taken from each patient before and two to three hours after beginning treatment and the pH, P_{CO_2} and standard bicarbonate were estimated by the microcapillary method (Siggard-Andersen *et al.* 1960) (Table 4).

Table 4
Acid-base balance: 8 patients with severe laryngotracheitis

	No.	*pH*	*P_{CO_2} (mmHg)*	*Standard bicarbonate (mEq/l.)*
Before intubation:				
Cardiac arrest	3	6·95 (6·80–7·17)	94 (34–150)	11·2 (10–16·5)
No cardiac arrest	5	7·32 (7·29–7·45)	48·4 (30–52)	20·5 (15–23)
After intubation	8	7·38 (7·25–7·50)	37·1 (23–50)	21·7 (17–30)

Three of these 8 patients had a cardiac arrest shortly after admission: they had a marked respiratory acidosis and a mean standard bicarbonate of 11·2 mEq/l.; they were intubated, given cardiac massage and intravenous sodium bicarbonate, with marked improvement in their clinical condition. The acid-base balance of 5 patients with no cardiac arrest but clinically in a state of cardiorespiratory failure is shown before intubation: in this situation the pH and P_{CO_2} are no guide to the severity of the obstruction and do not reflect the airway impairment or the resulting hypoxia, since the mean pH and P_{CO_2} differ little before and after intubation. The patients make greater respiratory efforts to overcome the increased airway resistance and, when central depression due to hypoxia occurs, cardiac arrest follows with little warning.

Four Patients Admitted Moribund

Out of 21 patients with severe upper airway obstruction 4 were admitted moribund with a history of difficulty in breathing for periods of under six hours. Three failed to respond to resuscitation by intubation, IPPV and cardiac massage and subsequently died.

One patient (Case 2) had a satisfactory cardiac output after external cardiac massage; IPPV was continued for 9 days. She died because irreversible cerebral hypoxia had occurred.

Case 2 Girl aged 4½ years

History: Well until 1 p.m. when she complained of sore throat and became restless; at 6 p.m. she developed rapid breathing followed by sudden stridor. Admitted at midnight in cardiorespiratory failure and external cardiac massage was performed.

On examination: Cyanosed; fixed, dilated pupils; blood pressure 80 mmHg systolic; body temperature 83°F; completely apnœic; flaccid paralysis of all limbs.

Emergency laryngoscopy showed an œdematous pyriform fossa with gross inflammatory swelling of the epiglottis and œdema of the aryepiglottic folds; the vocal cords were not visible. Oral intubation was followed by manual IPPV.

Course: IPPV by Barnet ventilator via a Rees naso-endotracheal tube was continued for nine days, until

death. No drugs were required to achieve control of ventilation and her blood pressure fluctuated hourly until it became unrecordable. The body temperature fell progressively to 80°F (26·7°C). Blood culture and throat swab yielded *H. influenzæ* resistant to penicillin. *Post-mortem examination:* Larynx: much swelling of the mucosa and parenchyma of the epiglottis and the the aryepiglottic folds: the swelling involved the whole of the upper part of the larynx down to the level of the vocal cords where it stopped abruptly. Brain: extensive necrosis, showing autolysis; the contents of the posterior cranial fossa had almost liquefied. Histology: epiglottis, larynx and aryepiglottic folds showed œdema and massive exudation of polymorphs and fibrin; the appearances suggested a blood-borne infection. Culture of organisms: *Hæmophilus influenzæ* from the blood and larynx.

Management

Mild degrees of upper airway obstruction due to laryngotracheitis are treated by conservative methods. The anæsthetist may be called to advise as to whether relief of the airway obstruction is required. A history of upper respiratory tract infection and stridor for over three days before admission, in the absence of pallor, restlessness and toxicity usually mean that conservative treatment will be effective.

Patients with severe upper airway obstruction have a history of stridor of under forty-eight hours, restlessness, toxicity, and pallor with marked increase in respiratory efforts; cyanosis is absent and is usually a late sign indicating severe anoxia due to the obstruction and, despite a normal acid-base balance, there may be a marked degree of hypoxia. When circulatory failure is evident it is essential to deal with the obstruction, before cerebral hypoxia occurs, by prolonged nasal intubation or tracheostomy until resolution has taken place. This allows removal of retained secretions in the lower airway by humidification and bronchial suction.

Direct laryngoscopy: Direct laryngoscopy is performed under general anæsthesia: induction is carried out with 100% oxygen with halothane. Particular attention is paid to the epiglottis and aryepiglottic folds. The adequacy of the laryngeal aperture is assessed by oral intubation.

The findings at laryngoscopy in 17 patients with severe laryngotracheitis were similar. There was œdema of the epiglottis and aryepiglottic folds sufficient to occlude the laryngeal aperture. No difficulty was encountered at oral intubation.

Correction of metabolic acidosis was based on the formula mEq/l. of Na HCO_3 required = 0·3 × weight (kg) × base deficit (mEq/l.) (Mellemgaard & Astrup 1960).

Intubation: The diameter of the naso-endotracheal tube should be smaller than the diameter of the oral tube which the larynx will admit during direct laryngoscopy. The naso-endotracheal tube length varies with age and is shown in Fig 2.

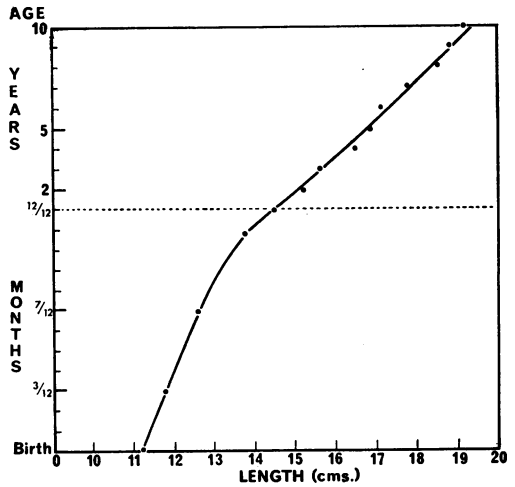

Fig 2 *Lengths of naso-endotracheal tubes*

After the initial emergency, nasal intubation is performed using Rees tubes, care being taken to fix the crosspiece of the tube securely to nylon tape; this tape is strapped to the cheek by adhesive waterproof strapping: after intubation, patients are nursed in an atmosphere of high humidity. Endotracheal suction is used only if retained secretions are thought to be troublesome or the child cannot cough.

Technique of bronchial suction: A disposable face mask is worn; the hands are washed but not dried. In patients under 6 months old, sterile plastic feeding catheters size 3 French gauge are used for endotracheal suction: they have less tendency to cling to the inside surface of the naso-endotracheal tube and the duration of suction is considerably shortened. In older children, angulated catheters with a single terminal hole are used (Bush 1963); their diameter must not exceed half the diameter of the naso-endotracheal tube and, to re-expand any possible atelectatic areas of lung caused by suction, IPPV by hand always follows suction (Rees 1958).

Extubation: Experience has shown that a naso-endotracheal tube used to relieve airway obstruction due to laryngotracheitis is likely to be necessary for at least five days. Elective laryngoscopy is usually planned at about seventy-two hours. Premedication consists of atropine given intravenously before induction of anæsthesia with 100% oxygen with halothane. If the supraglottic œdema has subsided, examination of the subglottic region is carried out under total paralysis with intravenous suxamethonium: dried secretions at the cricoid are commonly found and are removed by suction or Magill forceps. Extubation is performed after the onset of spontaneous respiration and the child nursed under supervision in a humidified atmosphere.

Neonatal Upper Airway Obstruction

Newborn infants will not breathe through the mouth; they breathe entirely through the nose, which accounts for 42% of the total resistance of breathing (Polgar & Kong 1965). The tortuous nasal airway and sharp angles at the anterior and posterior choanæ and larynx constitute a resistance but, despite this, nasal breathing remains instinctive until ten to fourteen days after birth (Moncrieff 1936). The larynx is higher and more anterior than in the adult and the epiglottis is large and floppy. A straight-bladed laryngoscope, therefore, facilitates intubation by lifting the epiglottis away from the laryngeal aperture. Thin-walled endotracheal tubes without a cuff or a built-in curve are best suited to the neonate.

Over the past ten years, out of 2,000 neonates admitted to the Alder Hey Children's Hospital, 44 had upper airway obstruction (Table 5). Twenty of these required emergency intubation on admission and this was followed by tracheostomy in 10 (23%). Nineteen (43%) of these 44 patients died, 12 from bronchopneumonia and 7 from asphyxia. The following were the main causes of obstruction:

Hydrocephalus with vocal cord paralysis: Fourteen patients with obvious hydrocephalus and myelomeningocele had stridor, cyanosis and dyspnœa; all required urgent endotracheal intubation. Laryngoscopy was done without anæsthesia, as flexing of the head cannot occur due to the immature cervical muscle development (Rees 1950) and there is no tendency for the patient to 'buck'. Ten patients treated by tracheostomy and IPPV died from associated bronchopneumonia.

Post-mortem examination of a hydrocephalus shows the vagus nerve hooked over the edge of the anterior border of the basi-occiput on its way to the jugular foramen; stretching of the vagus nerve in this manner has been suggested as the cause of vocal cord paralysis and resulting airway obstruction (Graham 1963, Pracy 1965).

Choanal atresia and choanal stenosis: Eight patients had obstruction to nasal breathing (Table 6). Of the 3 survivors 2 were intubated orally prior to surgical decannulation of the blocked nasal passages under general anæsthesia. The diagnosis is established if difficulty is found in passing a soft plastic feeding tube size 3½ French gauge through the nostril.

Bilateral choanal atresia constitutes a dire threat to the infant (Birrell 1960). No instruments are required for emergency resuscitation. A finger kept in the infant's mouth ensures that breathing can occur through the open mouth. This simple procedure relieves the emergency until an alternative airway is established.

Macroglossia: Of 10 patients with congenital macroglossia admitted to hospital, 2 were cyanosed and required emergency intubation prior to general anæsthesia for partial glossectomy. No difficulty was encountered at intubation and both patients survived. Upper airway obstruction at birth was relieved in one patient by nursing semi-prone at all times until, at 6 months of age, the macroglossia no longer interfered with breathing. Two patients with this condition were dead on admission to hospital.

Pierre Robin syndrome: Pierre Robin (1929) described the syndrome of glossoptosis, cleft palate and retrognathia which bears his name. Ten patients were admitted to hospital suffering from varying degrees of Pierre Robin syndrome. One patient required emergency intubation to relieve airway obstruction due to the tongue obstructing the larynx; he had severe retrognathia and later died of bronchopneumonia. Incoordination of the suck-swallow mechanism is also a major cause of airway obstruction in the Pierre Robin Syndrome. Burston (1966) has shown how this mechanism can be established over a period of time by conservative methods. Treatment consists of careful nursing and feeding and the use of an individually-designed cradle allowing the patient to be nursed prone in an incubator. Gravity prevents the tongue falling back and obstructing the larynx and aids drainage of secretions from the mouth.

Congenital absence of the nose: Congenital absence of the nose is a rare anomaly and has not been reported as causing airway obstruction (Fatin 1955). However, 2 such patients had severe airway obstruction from inability to breathe through the nose; both required emergency oral intubation for a period of four to six hours; clinical improvement followed, but one died from aspiration of regurgitated food two weeks later. In both cases the nasal septum was absent and there was mental retardation.

Table 5

Neonatal upper airway obstruction

	No.	*Emergency intubation*	*Dead*
Hydrocephalus with vocal cord paralysis	14	14	10
Choanal atresia	8	2	5
Macroglossia	10	2	2
Pierre Robin syndrome	10	1	1
Congenital absence of the nose	2	1	1
Total	44	20 (45%)	19 (43%)

Table 6

Airway obstruction due to choanal atresia and stenosis

Condition	*No.*	*Emergency intubation*	*Dead*
Bilateral atresia	3	–	3
Unilateral atresia	3	1	2
Bilateral stenosis	1	1	–
Unilateral stenosis	1	–	–
Total	8	2	5

Upper Airway Obstruction due to Foreign Body

Eighteen patients were admitted with a foreign body in the pharynx or larynx. Their ages ranged from 1 to 12 years. Five (28%) required urgent intubation to relieve cyanosis, dyspnœa and stridor. In 4 recovery was uneventful following removal of the foreign body.

One death occurred in a child who chewed her bed sheet at home: the sheet became impacted in the œsophagus, intermittently obstructing the larynx, finally causing anoxic cardiac arrest; emergency intubation and cardiac massage failed to reverse the situation and she died. This case emphasizes the importance of an examination of both œsophagus and trachea at laryngoscopy when there is a possibility of a foreign body, as the latter may be impacted in the upper end of the œsophagus.

The problem of a foreign body in the upper airway may be straightforward when the foreign body is radio-opaque, but this is not always the case; for example, a 15-month-old child came with a history very reminiscent of acute laryngotracheitis. At X-ray the upper airway was clear and no foreign body demonstrated. The child collapsed and at laryngoscopy a piece of aluminium foil measuring $1 \times 0{\cdot}5$ in ($2{\cdot}5 \times 1{\cdot}2$ cm) was removed from between the vocal cords. This foreign body was later found to be radiotranslucent.

In only one instance was a history of possible foreign body impaction obtained from the parents. All 5 patients required active intervention, intubation and relief of airway obstruction.

General anæsthesia in this group and in the miscellaneous group of upper airway obstruction for laryngoscopy and intubation was obtained by 100% oxygen with halothane, allowing the patient to breathe spontaneously (Bush 1965).

Miscellaneous Causes of Upper Airway Obstruction

Twenty-six patients were admitted with miscellaneous causes of upper airway obstruction (Table 7). Ten (38%) required emergency oral intubation, 4 were managed by prolonged naso-endotracheal intubation and 2 by tracheostomy. The following are the main groups:

Cystic hygroma: In a recent review of the anæsthetic problems of this condition, cystic hygroma is reported to be a rare cause of respiratory obstruction (MacDonald 1966). However, 7 patients were admitted with cystic hygroma of the neck and 3 of these had cyanosis, dyspnœa, tracheal tug and marked intercostal recession shortly after birth. On examination a large translucent swelling was present on the lateral aspect of the neck. Each patient was intubated prior to surgical excision of the tumour, 2 patients being free of airway obstruction immediately following operation, but one patient died two months later from a recurrence of the tumour within the larynx. Emergency oral intubation was performed in a third patient followed by prolonged nasal intubation for one week. This patient died suddenly six weeks later and post-mortem examination revealed that a cystic hygroma on the opposite side of the neck had compressed the trachea.

Hæmophilia: Twenty-seven patients with hæmophilia were admitted. Two, both aged 10 years, had acute obstruction of the upper airway due to gross trismus caused by a massive hæmatoma of the tongue and floor of the mouth; in both cases the anæsthetist was urgently summoned to relieve the obstruction but they needed neither active intervention nor intubation. Treatment was by rest in bed and fresh frozen plasma intravenously, with no therapy by intramuscular injection. Careful observations of the patient's colour, respiratory rate and pulse were made every fifteen minutes. A lateral X-ray of one patient showed the larynx displaced anteriorly by the hæmatoma. Extravasation of blood into the tongue and submental tissues is regarded as the most serious complication that can occur in hæmophilia but it is uncommon: over a period of forty-five years Biggs & Macfarlane (1957) found 16 patients with this complication.

The role of the anæsthetist in the management of the condition has been well documented (Leatherdale 1960). He must ensure that short nasopharyngeal tubes, suitable in size for the patient, suction equipment, oxygen and a laryngoscope are present at the bedside. Should an artificial airway be required, a nasopharyngeal tube lubricated with local anæsthetic is inserted beyond the tongue and eliminates the need for a hazardous tracheostomy.

Vocal cord burns: Two patients were admitted with stridor and cyanosis, following inhalation of hot fumes and smoke. At laryngoscopy done under general anæsthesia, the tonsils, fauces and uvula were inflamed and the epiglottis, aryepiglottic folds and vocal cords were charred and

Table 7

Miscellaneous causes of airway obstruction

		Intubation		
Disease	*No.*	*Emergency oral*	*Prolonged nasal*	*Dead*
Cystic hygroma	7	1	1	2
Hæmophilia	2	–	–	–
Vocal cord burns	2	1	1	–
Bilateral vocal cord paralysis	2	2	–	1
Measles	1	1	1	–
Glandular fever	1	1	1	–
Peritonsillar abscess	9	2	–	–
Retropharyngeal abscess	2	2	–	–
Total	26	10 (38%)	4 (15%)	3 (12%)

blackened. One patient with severe airway obstruction was treated by nasal intubation for eight hours. Both patients were nursed in high humidity and given iced fluids orally. Recovery was uneventful.

Bilateral vocal cord paralysis: Two patients were admitted, aged 1 month and 2 months. One died immediately following admission, despite intubation and resuscitation. The second survived after intubation and an emergency tracheostomy. Bilateral abductor paralysis is an acute emergency, the laryngeal opening being sealed off by the approximated vocal cords. Both these cases had hydrocephalus; raised intracranial pressure presumably paralysed both vagi (Pracy 1965).

Measles and glandular fever: Two patients had measles and glandular fever. One of them, aged 19 months, was admitted unconscious, with a history of cough, breathlessness, stridor and a sudden convulsion at home. Emergency laryngoscopy showed marked supraglottic œdema of the aryepiglottic folds. No difficulty was encountered at intubation, the tube being left for twelve hours. Three days later Koplik's spots and the morbilliform rash of measles appeared. Extubation was followed by an uneventful recovery. The second child, aged 11 years, arrived semiconscious and cyanosed, with marked interference with breathing; gross glandular enlargement was present in the neck, he also had generalized glandular enlargement and splenomegaly. His parents said he had had difficulty in breathing with stridor for one week. A differential white cell count showed a number of typical mononuclear cells and a Paul-Bunnell test confirmed the diagnosis of glandular fever. Emergency intubation was carried out under general anæsthesia with 100% oxygen with halothane and spontaneous respiration. At laryngoscopy the laryngeal aperture was almost closed by an inflamed tonsillar mass filling the pharynx and supraglottic area. Management was by nasal intubation for seventy-two hours; he was nursed in high humidity and antibiotics were given: extubation and recovery were uneventful.

Upper airway obstruction as a complication of measles is not recorded in 55,000 cases recently reviewed (Miller 1964). Between 1941 and 1958, only 6 cases of upper airway obstruction due to infectious mononucleosis were described (Librach 1951, Parsons & Dodds 1958). In each case, active intervention by tracheostomy was required to relieve the obstruction and no deaths occurred.

Peritonsillar abscess: Nine patients aged between 3 and 11 years were admitted with peritonsillar abscess. Two, aged 3 years, had gross trismus and were cyanosed and dyspnœic from obstruction to the upper airway. Oral intubation under general anæsthesia was followed by tracheostomy, after incision of the peritonsillar abscess. Both patients made an uninterrupted recovery.

Retropharyngeal abscess: Two patients, aged 6 and 8 years, arrived in a collapsed state requiring urgent oral intubation under general anæsthesia. Laryngoscopy showed a large fluctuant abscess lying in the pharynx in front of the bodies of the third and fourth cervical vertebra; generalized laryngeal œdema was present. Surgical drainage of the abscess relieved the obstruction and both recovered. Retropharyngeal abscess in childhood is usually secondary to a severe upper respiratory tract infection and the organism cultured in both cases was *Streptococcus pyogenes.*

Conclusion

Minor degrees of obstruction to the upper airway due to croup or acquired disease, are relatively common in childhood; they can be most satisfactorily treated by the pædiatrician, laryngologist or general surgeon. A small proportion of these patients develop severe or acute obstruction which threatens life; they come within the ambit of the anæsthetist working with children, either because he is called in an emergency or because he is consulted by the pædiatrician or pædiatric surgeon. The role of the anæsthetist in the treatment of upper airway obstruction in childhood is not an easy one, because there is a wide variety of causes, yet each is relatively uncommon and may be extremely rare. Moreover, the methods of treatment vary greatly, depending upon the lesion; considerable skill and experience are required for their successful use.

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